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09/931,862	08/20/2001	Hae-Kyoung Kim	249/274	3541

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EXAMINER

DOVE, TRACY MAE

ART UNIT

PAPER NUMBER

1745

DATE MAILED: 07/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/931,862

Applicant(s)

KIM, HAE-KYOUNG

Examiner

Tracy Dove

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-- Th MAILING DATE of this communication appears on the cover sheet with th correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 August 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 8/20/01 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,4
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Information Disclosure Statement

The information disclosure statements (IDS) submitted on 5/13/02 and 3/11/03 have been considered by the examiner. Note the IDS of 5/13/02 and the IDS of 3/11/03 contain duplicate referenced documents. All duplicated documents have been crossed out.

Specification

The disclosure is objected to because of the following informalities: on page 1, lines 20-21 the specification recites "a solid polymer electrolyte (SPE) fuel cell operable at a temperature of 600-1000°C", however, SPE fuel cells do not operate at this high temperature range. Kordesch et al, Fuel Cells and their Applications (1996), teaches that SPE fuel cells operate at a temperature of 50-80°C (page 52). Note the specification recites that solid oxide fuel cells operate at a temperature of 600-1000°C. Thus, it appears the high temperature range for SPE fuel cells is a typographical error.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 6, 15, 20 and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 6, 15 and 20 each recite "at least about 30%", which is indefinite. Specifically, 29% is "about 30%", but not "at least 30%. Thus, it is unclear if the claim encompasses, for example, 29%. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 6-12 and 15-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Bahar et al., US 5,635,041.

Regarding claims 1-3, Bahar teaches a composite membrane comprising a base material 4 and an ion exchange material/resin 2. The base material is a porous microstructure (porous support) and the ion exchange resin impregnates the membrane, i.e. base material (col. 3, lines 29-40). The ion exchange material may be comprised of at least in part a powder, such as but not limited to, carbon black, graphite, nickel, silica, titanium dioxide and platinum black (col. 2, lines 58-61). Optionally, the ion exchange materials may be complemented by finely divided powders or other (non-ionic) polymers to provide final composites. Such a finely divided powder may be selected from organic or inorganic compounds such as, but not limited to, carbon black, graphite, nickel, silica (SiO₂), titanium dioxide (TiO₂) or platinum black (catalyst). The powders provide specific added effects such as electrical conductivity, thermal conductivity, catalytic effects and/or enhanced or reduced reactant transport properties (col. 4, line 66-col. 5,

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line 8). Note silica and titanium dioxide are moisture retentive materials and platinum is a catalyst, as described in the instant specification (page 9, lines 9-21).

Regarding claims 6-7, a preferred base material is expanded polytetrafluoroethylene (ePTFE) having a porosity of greater than 35%, preferably between 70-95% (col. 3, lines 62-67).

Regarding claim 8, suitable ion exchange materials include perfluorinated sulfonic acid resin, perfluorinated carboxylic acid resin, polyvinyl alcohol, divinyl benzene, styrene-based polymers and metal salts with or without a polymer (col. 4, lines 58-63).

Regarding claims 9 and 23, a solution is prepared containing an ion exchange material (and optionally a finely divided powder). The solution may be applied to the base material by any conventional coating technique including roll coating, gravure coating, doctor coating, kiss coating, dipping, brushing, painting or spraying so long as the liquid solution is able to penetrate the interstices and interior volume of the base material (col. 6, lines 19-27).

Regarding claims 10-12 and 15-18, the composite membrane may be used in a fuel cell (claim 4). Ion exchange membranes are used in polymer electrolyte fuel cells as solid electrolytes (col. 1, lines 14-15). The composite membrane of Bahar may be used in various applications, including fuel cells and batteries (col. 3, lines 41-44).

Regarding claims 19-22, a direct methanol fuel cell (DMFC) has the same structure as the polymer electrolyte membrane fuel cell (PEMFC), but uses liquid methanol, instead of hydrogen, as a fuel source (see page 3, lines 13-14 of the instant specification "Description of Related Art). Thus, the direct methanol fuel cell of claim 19 is a polymer electrolyte fuel cell (taught by Bahar). Note that whether methanol or hydrogen is used as the fuel source, the fuel cell is a

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polymer electrolyte type fuel cell (the terminology of the preamble does not limit the claimed structure MPEP 2111.02).

Thus, the claims are anticipated.

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Claims 1, 2, 5-11 and 14-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Grot et al., US 5,919,583.

Regarding claims 1, 2, 6, 7, 10, 11, 15, 16, 19 and 21, Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. The membrane exhibits reduced fuel crossover for fuel cells employing direct feed organic fuels such as methanol (see abstract). Preferably the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and phosphates of zirconium, and mixtures thereof. The inorganic proton conductor comprises 2-30 wt% of the membrane (col. 2, lines 25-38). The membrane may optionally include a porous support for improving mechanical properties. The porous support may be a polyolefin (polyethylene or polypropylene) or polytetrafluoroethylene (PTFE) having at least 40% porosity (col. 5, lines 1-31). A membrane can be made using a porous support by coating cation exchange polymer on the support so that the coating is on the outside surfaces as well as being distributed through the internal pores (impregnates) of the support (col. 5, lines 32-33). The inorganic filler is dispersed in the membrane (impregnates) and may further be a zeolite material (col. 5, lines 58-63). Note titanium dioxide, zirconium oxide, mordenite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21).

Regarding claims 5, 8, 14, 17, 20 and 22, the cation exchange groups of the polymer are selected from the group consisting of sulfonate, carboxylate, phosphonate, imide, sulfonimide and sulfonamide. In a preferred embodiment, highly fluorinated polymer with sulfonate groups is employed (col. 2, lines 39-50). The term "sulfonate groups" is intended to refer either to sulfonic acid groups or alkali metal or ammonium salts of sulfonic acid groups (col. 3, lines 57-60). Example 2 teaches a solution containing a sulfonated perfluorocarbon copolymer having as a perfluorocarbon backbone and side chains $\text{-O-CF}_2\text{CF}(\text{CF}_3)\text{-O-CF}_2\text{CF}_2\text{SO}_3\text{H}$ in hydrogen ion form and which has an equivalent weight of about 1080. Tin mordenite is added to the solution and the solution is poured onto a polytetrafluoroethylene sheet substrate (porous support).

Regarding claims 9, 18 and 23, a solution of an inorganic filler and a polymer ionic form can be used to apply a coating to a porous support to form the membrane (col. 6, lines 42-46). The polymer is distributed through the internal pores of the support (col. 5, lines 32-35) and the inorganic filler is incorporated into the membrane (col. 6, line 40). Thus, the membrane of Grot is formed by impregnating the porous support with a composition of ion-exchange polymer and the inorganic filler (reinforcing agent).

Thus the claims are anticipated.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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Claims 1-4, 8, 10-13, 17 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al., US 5,766,787 in view of Grot et al., US 5,919,583.

Watanabe teaches a solid polymer electrolyte fuel cell comprising a solid polymer electrolyte membrane incorporating 5.8 wt% platinum catalyst and 5 wt% silica in Nafion (perfluorocarbon sulfonic acid cation exchange resin) or 5.8 wt% platinum catalyst and 5 wt% titania (TiO_2) in Nafion. See col. 6, lines 40-48 and col. 8, lines 23-64. Thus, the platinum catalyst is about 54 wt% and the silica (or titania) is about 46 wt% of the total amount of catalyst plus metal oxide (reinforcing agent) contained in the polymer electrolyte membrane. The membrane comprises 0.01-80 wt% of at least one metal catalyst (Pt, Au, Pd, Rh, Ir and/or Ru) and 0.01-50wt% of particles and/or fibers of at least one metal oxide (silica, titania and/or zirconia). See col. 3, lines 29-42. Methanol gas and oxygen gas may be used as the reactant gases for the fuel cell (col. 3, lines 57-59).

Watanabe does not explicitly state the polymer electrolyte membrane includes a porous support.

However, Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. The membrane exhibits reduced fuel crossover for fuel cells employing direct feed organic fuels such as methanol (see abstract). Preferably the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and phosphates of zirconium, and mixtures thereof. The inorganic proton conductor comprises 2-30-wt% of the membrane (col. 2, lines 25-38). The membrane may optionally include a porous support for improving mechanical properties, for decreasing cost and/or other reasons. The porous support may be a polyolefin (polyethylene or

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polypropylene) or polytetrafluoroethylene (PTFE) having at least 40% porosity (col. 5, lines 1-31). A membrane can be made using a porous support by coating cation exchange polymer on the support so that the coating is on the outside surfaces as well as being distributed through the internal pores (impregnates) of the support (col. 5, lines 32-33). The inorganic filler is dispersed in the membrane (impregnates) and may further be a zeolite material (col. 5, lines 58-63). Note titanium dioxide, zirconium oxide, mordenite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21).

Therefore, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because one of skill would have been motivated to incorporate a porous support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties and/or decrease the cost of the membrane (see Grot col. 5, lines 1-3). Grot teaches that the polymer electrolyte membranes optionally include a porous support. Therefore, one of skill in the art would be motivated to provide a porous support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties of the membrane and/or to decrease the cost of the membrane. Grot teaches membranes containing a cation exchange polymer and a reinforcing agent (as defined by the instant specification) may or may not include a porous support. Both Watanabe and Grot teach direct methanol fuel cells.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Brodd et al. 6,156,458 teaches a solid electrolyte containing a polymeric matrix and a toughening agent such as silica or zeolite (abstract). Peled et al. 6,447,943 teaches a fuel cell

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with a proton conducting membrane (PCM) including PVDF and silicon dioxide (col. 8, lines 25-33).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tracy Dove whose telephone number is (703) 308-8821. The Examiner may normally be reached Monday-Thursday (9:00 AM-7:30 PM). My supervisor is Pat Ryan, who can be reached at (703) 308-2383. The Art Unit receptionist can be reached at (703) 308-0661 and the official fax numbers are 703-872-9310 (after non-final) and 703-872-9311 (after final).

Tracy Dove
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Art Unit 1745


7/10/03